PRECIPITATION LEVEL ANALYSIS AND ESTIMATION FOR THE MODELING OF RIVER FLOW INTO THE MAYAGÜEZ BAY USING ARTIFICIAL NEURAL NETWORKS

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When high levels of urban development, and erratic patterns of high precipitation combine in a small geographical area, there is a significant increase in the risk of human and/or material losses due to flooding and related incidents. If left unchecked, these incidents can result in severe, long-term economic disruption in affected regions. In addition, the rivers that flow into the Mayagüez Bay typically carry large amounts of river sediment into the bay, which poses potential alterations to the ecosystems within the bay.

In face of the current availability of inexpensive processing platforms, Artificial Neural Networks (ANN) have emerged as a promising method for the estimation and prediction of noisy and/or complex time-series data, such as solar activity, stock market prices, and biological data, that eludes conventional methods, such as regression analysis and linear predictors, in reasonably small timeframes.

With the objective of providing the framework for the development of tools for the estimation of precipitation patterns in an area with a high risk of flooding, this work describes the design and implementation of a neural-network-based system as a potential solution.

The Tropical Rainfall Measuring Mission (NASA-JAXA) was a satellite mission with the objective of collecting tropical precipitation data. This mission managed to collect nearly uninterrupted hourly data from January 1998 until March 2015: Nearly 17 years' worth of data points. With the use of TRMM satellite data, and ground station flow measurements in three different rivers: Yaguez, Grande de Anasco, and Guanajibo, four independent models are developed for the estimation of the behavior of these magnitudes: one for estimating precipitation levels according to their evolution across time, and three separate ones for estimating the flow of each individual river as a function of the available (and, for future values, estimated) precipitation data.

Our results confirm and demonstrate the capabilities of Artificial Neural Networks as a modeling and parameter estimation tool for applications with a particularly noisy behavior, such as the case of precipitation and river flow measurements. These capabilities extend to the possibility of estimating missing samples, in cases where data is available for a large period of time, but is sampled at inconsistent/long intervals.

With the continuous future addition of measured data, and with this, increased understanding by the models of the behavior of the precipitation and flow variables of interest, these models could aid in the prevention of human and/or material losses due to river flooding and associated incidents by providing an early warning for agencies to dispatch support teams, evacuate areas, and overall create awareness inside high-risk zones along riverbanks.